Technical Documents

TOAGOSEI CO.,LTD.

Negative Thermal Expansion Filler

ULTEA®

What's ULTEA?

ULTEA is inorganic powder that contracts in response to increasing temperature.
Addition of ULTEA to glass or resin can control their thermal expansion.

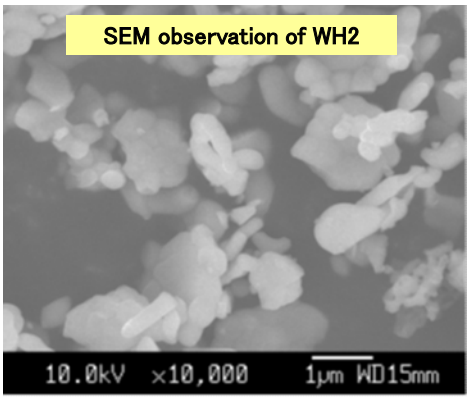
Main Features

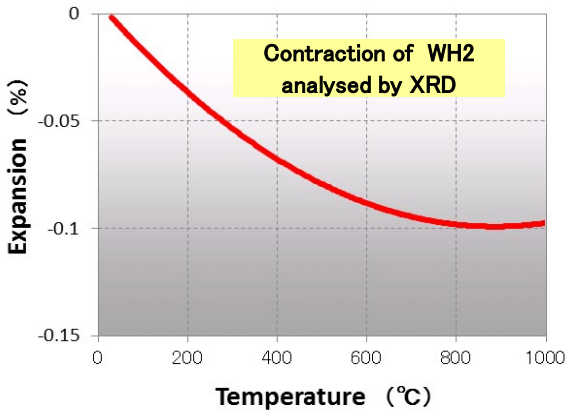
☆Negative thermal expansion appears over a wide range of temperature (up to 800℃).
☆Low toxicity: Heavy metal free.

General Properties

	Diameter (μm)	CTE[1] ($\times 10^{-6}$/K)	Bulk specific gravity (g/cm^3)	True specific gravity (g/cm^3)	Heat resistance (℃)	Features
WH2	1～2	−2	0.8	3.2	1000	good glass flowability

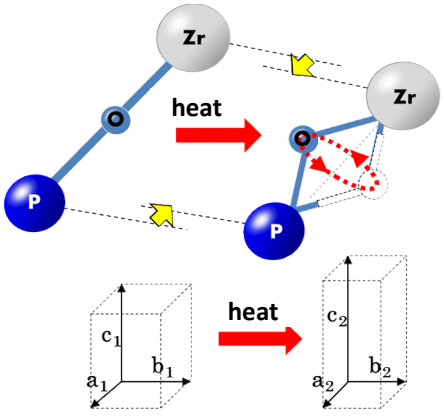
1) coefficient of thermal expansion calculated by XRD (X-ray diffraction) method (30～500℃)





Mechanism of Negative Thermal Expansion

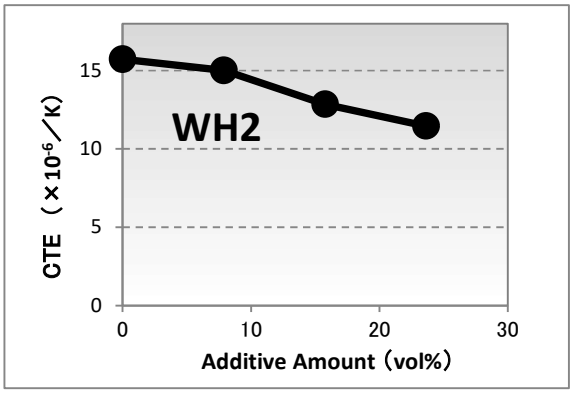
ULTEA has an interesting feature that contracts upon heating rather than expanding as most materials do. According to data of lattice parameters of ULTEA analysed by XRD, C-axis expands while A- and B-axis contract upon heating. Considering the volume change, it is calculated that ULTEA contracts upon heating on average. This feature is thought to depend on its special kind of crystal structure, Zr-O-P bond changes its angle by heating. ULTEA shows reversibly-change of lattice parameter, so its negative thermal expansion appears unless its crystal structure is collapsed.



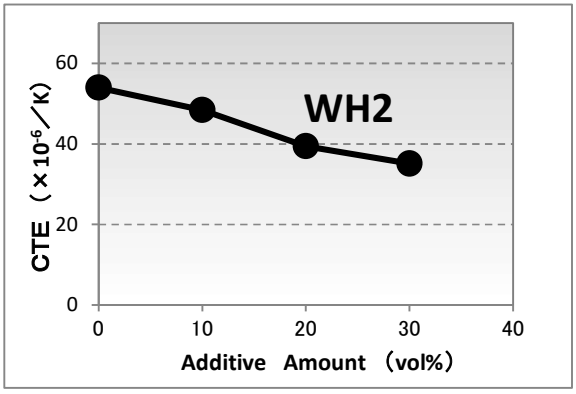
$a_1 > a_2$, $b_1 > b_2$, $c_1 < c_2$

Performance

Left figure shows CTE of ULTEA-added phosphate glass, melted at 520℃. Right figure shows CTE of ULTEA-added epoxy resin, bisphenol epoxy with acid anhydride, thermally cured at 150℃. Both

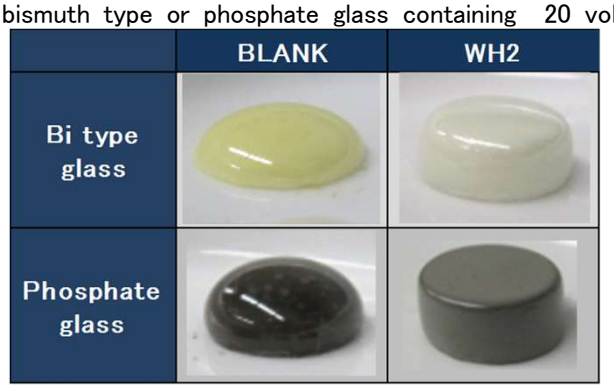


CTE variations of phosphate glass



CTE variations of epoxy resin

Fluidity of bismuth type or phosphate glass containing 20 vol% of ULTEA is



Safety

Safeties of ULTEA WH2 is confirmed by various examinations.

ULTEA	Acute oral toxicity rat-LD_{50} (mg/kg)	Mutagenicity (Ames test)	Primary skin irritation (P.I.I.)	Fish toxicity LC_{50} (mg/dm^3)	Alga growth inhibition ErC_{50} (mg/dm^3)	Daphnia acute toxicity EC_{50} (mg/dm^3)
WH2	>5000	Negative	0	>100 (0-96hr)	>100 (0-72hr)	>133 (0-48hr)

Applications

Sealing glass (for PDP, OEL, fluorescent display tube), sealing resin (EMC, epoxy sealant), etc.

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TOAGOSEI

1-14-1, Nishi-Shimbashi, Minato-Ku, Tokyo 105-8419
Performance Chemicals Division
Amenity Care & Electronics Material Department
Tel : +81-3-3597-7960
Mail : new-inorganic@toagosei.co.jp

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